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Pyrolysis of Biomass Waste and Product Upgrading (Using Water Sachet as Case Study)

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I. INTRODUCTION

Renewable energy is becoming more important as environmental worries about the use of fossil fuels and its role to the Greenhouse Effect rise. Wood and other kinds of biomass are some of the most common renewable energy resources, and they are the only renewable liquid, gaseous, and solid fuels accessible. Wood and biomass may be utilized to generate energy in a number of methods, including direct burning, gasification, and quick pyrolysis.

For a typical woody biomass, the three principal ingredients are half cellulose, a quarter hemicelluloses containing extractives, and a quarter lignin. The cellulosic fibers are bound together by a matrix of lignin and hemicelluloses, which is comparable to the notion of polyester resin fiber glass fibers. Cellulose is a linear polymer that contains 49 wt% oxygen and has a degree of polymerization (DP) of up to 10,000 six-carbon anhydro glucose sugar units. Hemicelluloses have a lower DP of 100 to 200 heterogeneously connected six-carbon and five-carbon anhydro sugars, making them chemically comparable to cellulose.

When biomass is heated, it undergoes a series of physical and chemical changes. To begin, pyrolysis happens when solid char, condensable liquids, and gases are heated in the absence of oxygen or air to form a combination of solid char, condensable liquids, and gases. Fast pyrolysis is a phrase used in this work to describe a method designed to maximize the generation of condensable organic vapors with the least amount of gas and char. Many larger-scale rapid pyrolysis reactor designs add a tiny amount of air to recycled char or recycled pyrolysis gases to supply process heat via partial combustion, but do so in a way that does not affect condensable organic yields (Jenkinson, 2010).

Gasification is a process that produces non-condensable gases by adding a tiny quantity of oxygen or air (sub-stoichiometric) to the reactor directly to generate process heat for the gasification processes. Pyrolysis is a step on the way to gasification. Combustion is the process of immediately injecting air or oxygen into a reactor in sufficient quantities to totally oxidize the biomass (stoichiometric), generally with an excess of oxygen to ensure bum-out. When biomass is burned, it is first pyrolyzed into gases and organic vapors, which are then burned in flame combustion. Pyrolysis technique can create biofuels with high fuel-to-feed ratios. Therefore, pyrolysis has been receiving more attention as an efficient method in converting biomass into bio-fuel during recent decades (Rozich & Gaudy 2012). (Rozich & Gaudy 2012). The ultimate goal of this technology is to produce high-value bio-oil for competing with and eventually replacing non-renewable fossil fuels. The development of new technologies, on the other hand, will be the next challenge for pyrolysis researchers in order to meet this goal. To be used directly in automobiles, trains, ships, and airplanes, biomass must be converted into liquid fuels.

A. Statement of Problem

It has been revealed that the average life span of man is decreasing all throughout the world, particularly in emerging countries. Environmental contaminants such as solid, liquid, and gaseous wastes are a big problem. Municipal and public garbage management is currently the most pressing environmental issue confronting emerging countries, particularly Nigeria. Heavy, unmanageable solid waste is fouling up the cities. Because of Nigeria's current economic position, water is packed in low-density polyethylene (LDPE) sachets, which are the most cost-effective packaging material. It has grown popular in practically all towns, but because LDPE has such a low rate of degradation, it has unfortunately resulted in a new form of solid waste. Pyrolysis is the most cost-effective process for converting LDPE waste into valuable goods. The pyrolysis process is thought to start about 325oC and continue up to a maximum temperature of 850^{o}C (Gorton & Knight, 2014)

B. Aim of the Study

The goal of this project is to create and improve a liquid product from the pyrolysis of biomass waste.

C. Objectives of the Study

The following objectives will be used to attain the goal:

1) Collection of water sachet
2) Treatment of the water sachet
3) Pyrolyze known weight of dried (pieces) of water sachet.
4) Identify the liquid that was created.
5) Make a comparison between the liquid product and gasoline fuel.

D. Scope of the Study

This study uses sachet water as a case study to look at quick pyrolysis of biomass for the generation and upgrading of liquid fuels. The fundamental ideas relating to the accomplishment of quick pyrolysis and product upgrading on research, bench, and pilot scales are explained. There is a description of the items as well as their prospective applications.

II. METHODOLOGY OF STUDY

A Fabricated batch reactor with lagging for effective heat transmission, Thermocouple, Mercury manometer, 750ml gas cylinder, Electric heater, Gas Chromatography, Condensing flask, Weighing balance, Water, and a Beaker were utilized to carry out this investigation.

Polyethylene garbage was collected around campus, and the sample was cleaned with water to eliminate contaminants before being sundried. To increase the surface area available for pyrolysis, the sample was chopped into smaller pieces (Scott & Piskorz, 2014).

The pyrolysis experiment was carried out in an airtight cylindrical reactor made of stainless steel (length 210mm, inner diameter 22mm) with connecting pipes flowing in and out for gas conveyance and product collection, respectively (Diebold, 1999). To guarantee minimum loss of gaseous products, an outgoing pipe was linked to a condensing flask dipped in ice and kept at 4°C. After an initial purging with nitrogen for 30 minutes, the reactor was stacked with 100g of waste low density polyethylene film (shredded table water sachets). At 474oC (45 minutes into the reaction), oil droplets began to accumulate in the condensing flask, indicating that the temperature was progressively rising, The collection was permitted to continue for another 1 hour 5 minutes until the reaction was shut down when the gas evolution halted. The temperature range for the experiment was 474-520oC, which corresponded to the temperatures at the first visible evidence of gas development and the end of the experiment.

Furthermore, the heat was withdrawn, and the contents, which were an opaque, light (not thick) liquid, were poured onto a metal plate and swiftly cooled into a grease-like material. Material balance was used to assess the weight of the gaseous product after the oil was weighed.

III. CONCLUSION

This article looked into sachet water as well as rapid pyrolysis of biomass for the production and upgrading of liquid fuels. The basic concepts relevant to achieving rapid pyrolysis and product upgrading were discussed.

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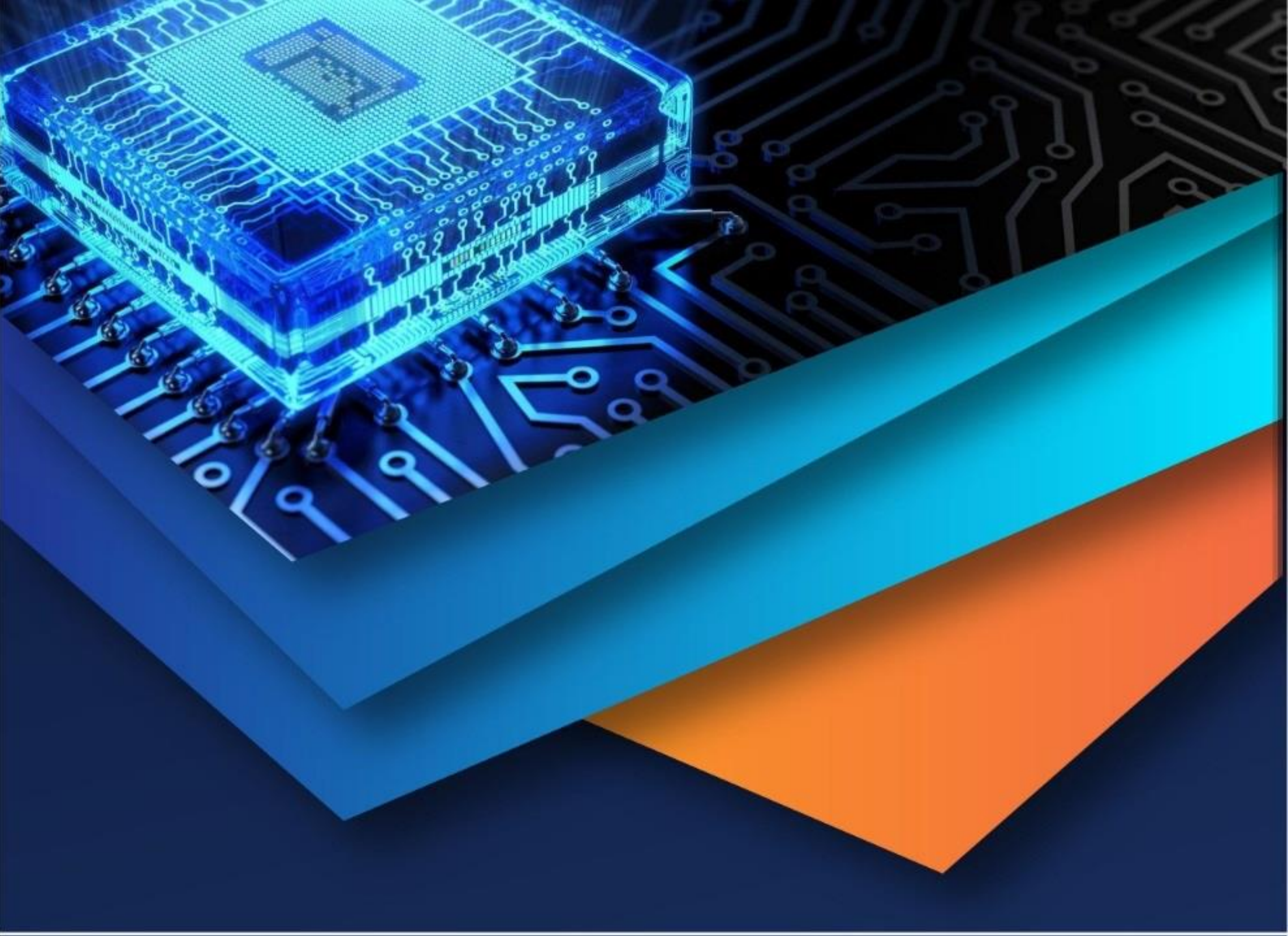

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